Basewide Energy Systems Plan for Aberdeen Proving Ground

Volume I

Executive Summary

Final Report

Prepared for:

U.S. Army Corps of Engineers

Norfolk District

Prepared by:

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August 1983

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BASEWIDE ENERGY SYSTEMS PLAN

FOR

ABERDEEN PROVING GROUND

ABERDEEN, MARYLAND

AND

EDGEWOOD, MARYLAND

VOLUME I

EXECUTIVE SUMMARY

FINAL REPORT

PREPARED FOR:

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ARMY CONTRACT NO. DACA65-80-C-0015
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AUGUST 1983

INDEX OF ENERGY ENGINEERING ANALYSIS

PROGRAM WORK AT ABERDEEN PROVING GROUND

WORK SUBMITTED MARCH 1982

*Updated August 1983

INDEX OF ENERGY ENGINEERING ANALYSIS

PROGRAM WORK AT ABERDEEN PROVING GROUND (CONTINUED)

EXECUTIVE SUMMARY

This report presents the results of the Energy Engineering Analysis (EEA) Program conducted at the Aberdeen Proving Ground, Aberdeen, Maryland, by JRB Associates, (JRB) under Contract No. DACA65-80-C-0015. The report includes analyses of the energy use patterns at the base and the identification and evaluation of energy conservation opportunities. The results obtained indicate that energy use at Aberdeen Proving Ground (APG) can potentially be reduced by over 20 percent by FY 1985, compared to the FY 1975 use baseline.

This report is organized into three volumes: Volume I - Executive Summary, Volume II - Main Report and Facility Engineer Conservation Measures, and Volume III - Appendices and ECIP projects. The Main Report is divided into three sub-volumes. This report is the first volume of the overall three volume basewide energy systems study at APG. These volumes are:

Volume I : Executive Summary
Volume IIa-1: Main Report: Increments A, B, and G
Volume IIa-2: Main Report: Increments C, D, and E
Volume IIb : Facility Engineer Conservation Measures: Increment F
Volume III : Appendices and ECIP Projects

Volume IIa-1 of the report, which deals with Increments A, B, and G of the EEA study, is organized into four sections as follows:

- Section 1. Provides a description of the APG facility and discusses the scope of the energy conservation study. This section also provides an overview of the approach used by JRB to perform the work.
- Section 2. Provides an overview of energy use at APG for FY 1979 and a fuel use profile for the past three years.
- Section 3. Discusses JRB's analysis of the energy supply and distribution systems.
- Section 4. Contains the results of JRB's analyses of potential energy conservation projects and discusses the methods employed to determine project costs and energy savings. This section also discusses future construction, demolition, site conservation efforts, and the progress achieved towards mandated conservation goals.

Initial data for the study was gathered during a series of site visits and included an inventory of heated buildings, patterns of building energy use, and historical energy use over the past three years. A summary of the base heated building inventory, together with FY 1979 energy use, is shown in Table 1. The summary of energy use over the past six years, as shown in Table 2, indicates that the total energy use at APG has been reduced approximately five percent in the last three years.

Figure 1 illustrates the total energy use in buildings by fuel type. Fuel oil accounts for approximately 57 percent of the total, followed by electricity at approximately 42 percent. Monthly patterns of energy use were analyzed, and this research showed that the peak fuel oil usage occurred during the winter months due to space heating demands. Electricity use peaked in the summer months due to the use of electrically-driven cooling equipment.

The central heating systems were examined in detail. Steam is supplied to many of the buildings from 58 central boiler plants and is used for heating, domestic hot water, and process heat. Some buildings have individual boilers, space heaters or furnaces. Energy losses in the steam distribution systems through insufficiently insulated piping systems, leaks, and malfunctioning steam traps are being corrected by Facilities Engineering. A breakdown of the fuel oil energy end uses is shown in Figure 2.

A similar analysis was performed of the electrical system. Transformer and distribution losses account for about 8 percent of the total electrical power delivered to the site. Figure 3 summarizes the electrical energy use profile.

A detailed study of energy conservation opportunities at Aberdeen Proving Ground indicates that major steps have been and are being taken to meet energy goals. The many projects that have been implemented or programmed through the Facilities Engineering Directorate are discussed in Section 4 of the Main Report. Table 3 summarizes these projects. A checklist was developed by JRB to analyze additional energy conservation opportunitites, using the master list provided in the Army Facilities Energy Plan. These opportunities were

TABLE 1. ABERDEEN PROVING GROUND - BUILDING ENERGY USE AND INVENTORY SUMMARY

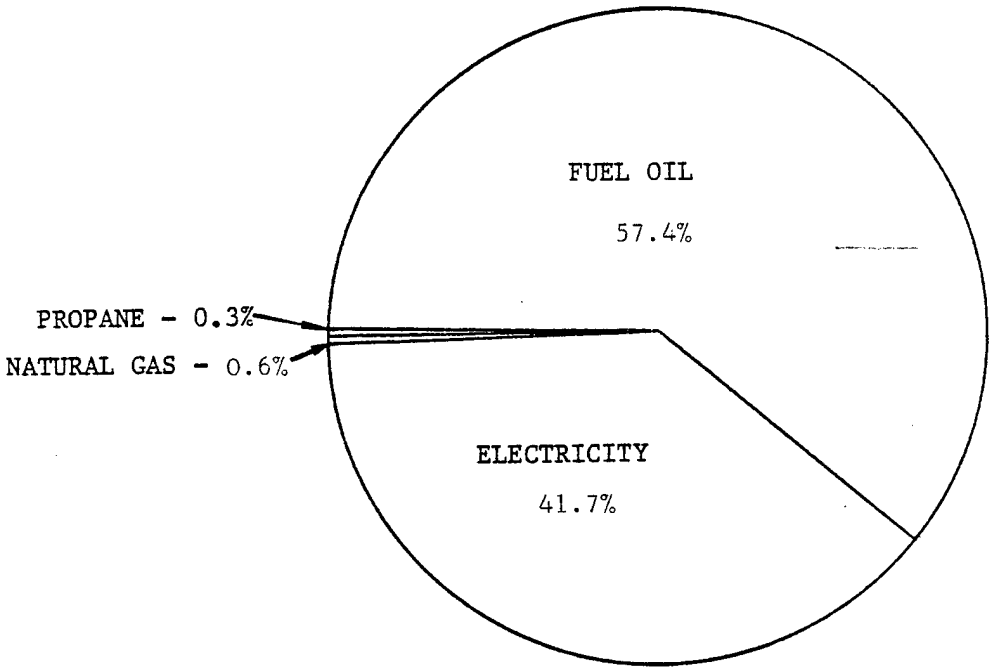
BUILDING CATEGORY	TOTAL NUMBER OF BUILDINGS	TOTAL FLOOR AREA (SQUARE FEET)	TOTAL ENERGY USE IN FY 1979 - (Btu x 10^9*)
OFFICES	144	1,652,008	445.5
RESEARCH & DEVELOPMENT	233	2,295,946	941.8
HOUSING	419	3,017,102	354.2
WAREHOUSES	108	1,026,299	165.3
SHOPS	106	1,503,897	350.1
SERVICE	133	1,023,219	204.5
TOTAL	1,143	10,518,471	2,461.4

* The total energy use excludes powerhouse energy use, and distribution and other losses.

TABLE 2. ENERGY USE AT ABERDEEN PROVING GROUND FY 1977 to FY 1982

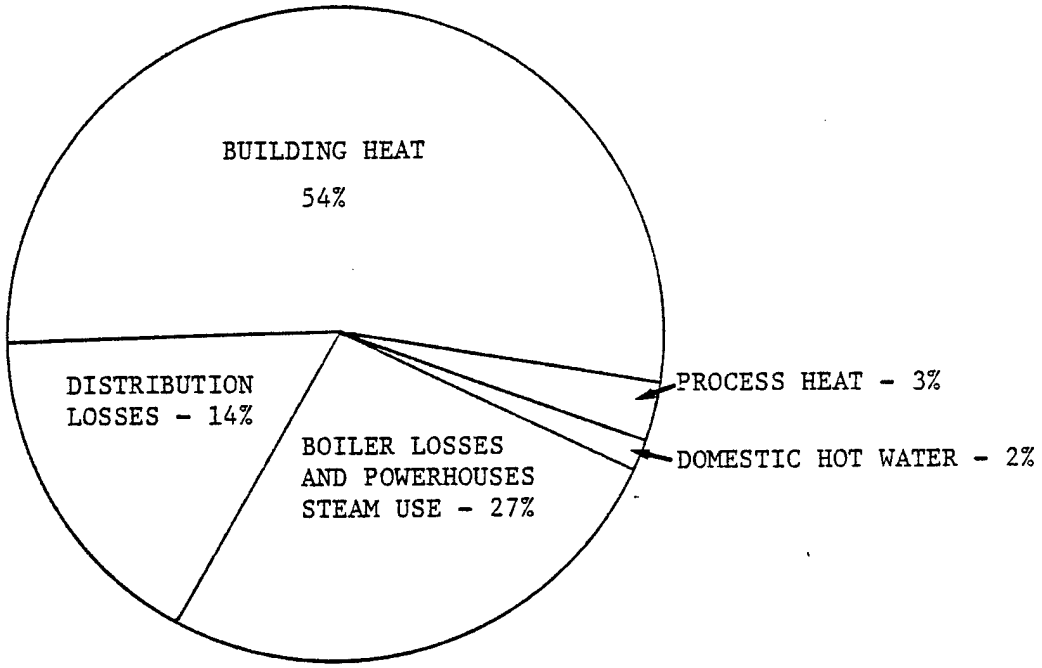
FUEL TYPE	FY 1977 $_{6}$ Btu x 10^{6}	FY 1978 $_{6}$ Btu x 10^{6}	FY 1979 $_{6}$ Btu x 10^{6}	FY 1980 $_{6}$ Btu x 10^{6}	FY 1981 $_{6}$ Btu x 10^{6}	FY 1982 $_{6}$ Btu x 10^{6}
FUEL OIL	2,174,904	2,156,200	2,198,723	1,967,531	2,002,739	1,964,686
ELECTRICITY	1,375,238	1,415,954	1,381,549	1,369,089	1,374,276	1,426,580
NATURAL GAS	22,538	20,640	19,065	17,511*	19,010*	20,037*
PROPANE	10,652	10,849	9,913	8,756*	9,505*	10,018*
TOTALS	3,583,337	3,603,643	3,609,250	3,362,887	3,405,530	3,421,321

*Natural gas and propane were available as total combined, therefore FY 1980-1982 are ratios based on FY 1977-1979.



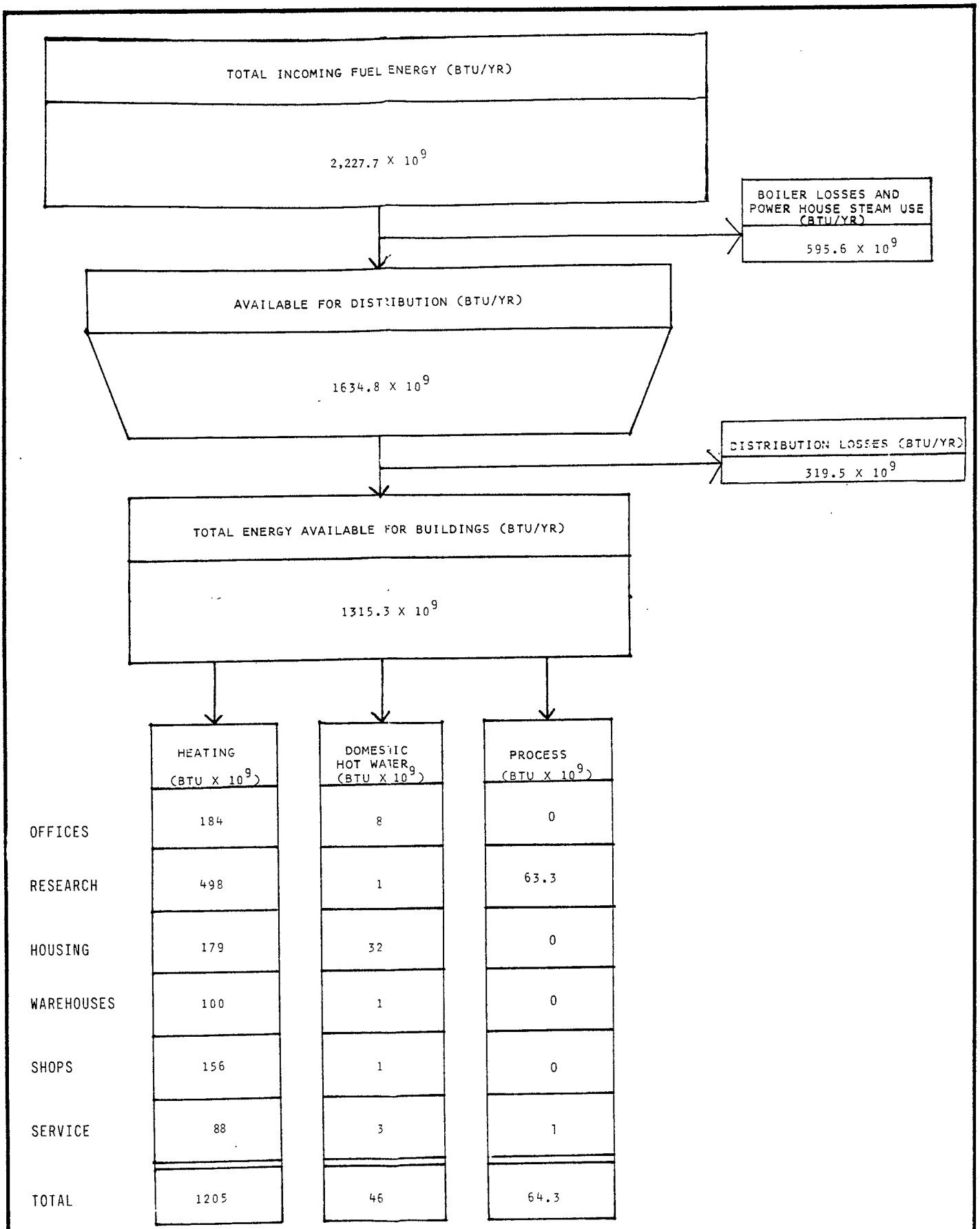
TOTAL ENERGY USE - 3,421,321 MBtu per year

FIGURE 1. TOTAL ENERGY USE IN BUILDINGS BY FUEL TYPE, ABERDEEN PROVING GROUND — FY 1982



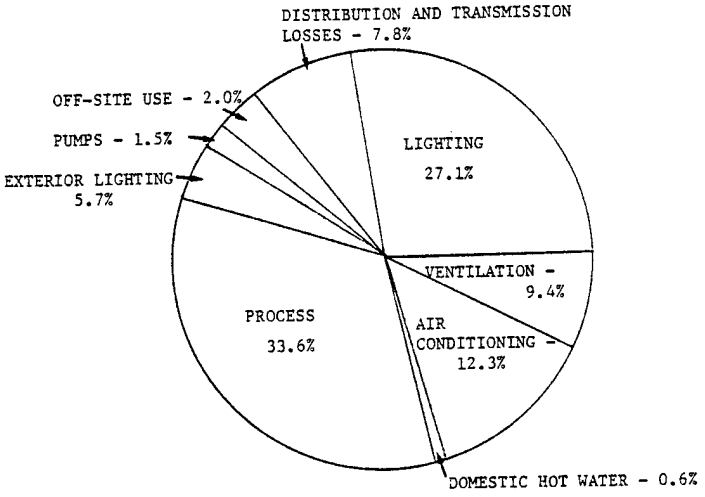
TOTAL HEATING FUEL EQUIVALENT - $2,227.7 \times 10^9$ Btu per year

FIGURE 2. END-USE OF HEATING FUEL AT ABERDEEN PROVING GROUND — FY 1979



	HEATING (BTU X 10^9)	DOMESTIC HOT WATER (BTU X 10^9)	PROCESS (BTU X 10^9)
OFFICES	184	8	0
RESEARCH	498	1	63.3
HOUSING	179	32	0
WAREHOUSES	100	1	0
SHOPS	156	1	0
SERVICE	88	3	1
TOTAL	1205	46	64.3

FIGURE 2 (cont'd)



TOTAL ON-SITE ELECTRICITY USE - 119,099 x 10^3 kWh per year

FIGURE 3. ELECTRICAL ENERGY USE PROFILE AT ABERDEEN PROVING GROUND — FY 1979

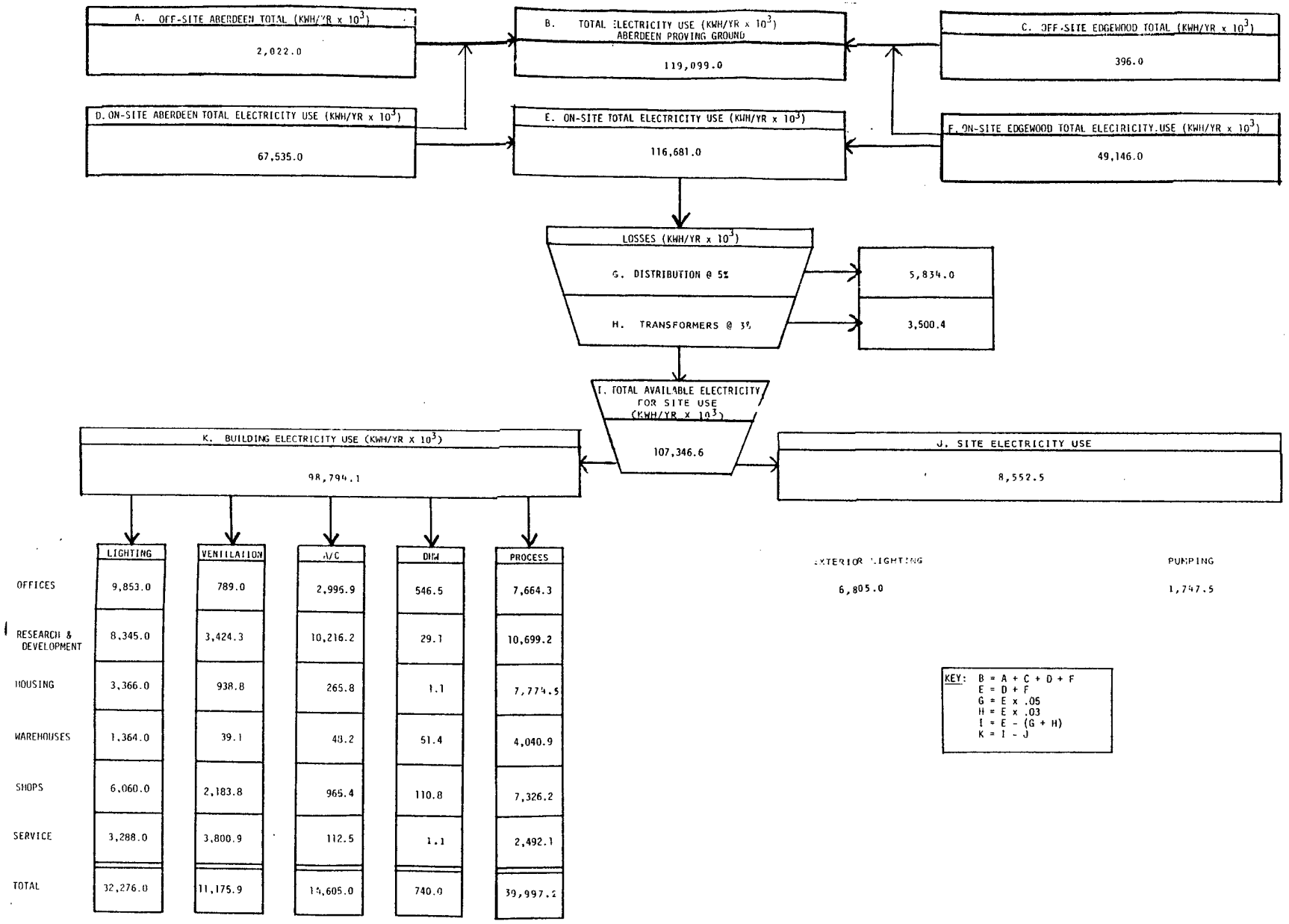


FIGURE 3. (cont'd)

TABLE 3. SITE ENERGY CONSERVATION PROJECTS

ITEM	PROJECT TYPE	TOTAL RAW SOURCE ENERGY SAVINGS (MBtu/Year	STATUS
3	Ceiling Insulation 77 R&D, Administration	8,839.4	Completed 1981
8	Storm Windows 69 Buildings	31,071.0	Completed 1978
9	EMCS - Aberdeen Area	223,899.0	Under Contract 1983
11	Rotary Cup Burners	55,480.0	Completed 1978
15	Wall Insulation FH Areas 10 & 11	1,719.0	Completed 1978
16	Wall Insulation FH Area 12	1,577.8	Completed 1977
17	Wall Insulation FH Area 9	1,305.3	Completed 1978
18	EMCS - Edgewood Area	32,315.0	Under Contract 1983
19	Storm Windows 66 Buildings	13,086.0	Under Contract 1983
21	Storm Windows FH Areas 21 & 22	1,164,5	To be resubmitted 1983
22	Storm Windows FH	2,032.7	Completed 1979
24	Storm Windows 49 Dwellings	1,708.7	Completed 1979
29	FH Night Setback Thermostats	19,900.0	Submitted to BDE 1983
25	Heating Plant Shutdown	22,095.0	Completed 1982
27	Storm Windows FH - 7 Units	467.8	Submitted to BDE 1983
28	Ceiling Insulation Public Quarters	4,268.4	Submitted to BDE 1983
	Building 316 Economizer Cycle	4,239.5	Completed 1982
	TOTAL	425,169.1*	

*Note: Estimated savings of projects already completed are equal to 130,067 MBtu/year. The remaining projects in the APG energy program have estimated savings of 295,102.1 MBtu/year.

checked for their applicability to typical buildings, as were applicable, economic feasibility and engineering analyses were performed. Field surveys were then utilized to verify that the selected energy conservation proejcts were indeed both feasible and required in the builidngs proposed. The energy conservation projects analyzed, and their ultimate disposition, are shown in Table 4. The resulting Energy Conservation Investment Program (ECIP) and O&M projects are presented in Subsections 4.6 and 4.7 of Volume IIa-1. Tables 5 and 6 summarize these projects. The impact of new construction and plans for the demolition of approximately 150 builidngs by FY 1985 were also considered in arriving at the total projected energy savings.

Aberdeen Proving Ground has initiated several operation and maintenance procedures and projects to save energy. These include the insulation and repair of steam lines, reduced operation of air conditoning systems, and an extensive delamping program. JRB identified some additional areas for energy savings, the majority of which will require minimal time and money to implement.

The analyses indicate a potential for savings of 20 percent in total energy use by FY 1985 compared with the FY 1975 energy use baseline. The magnitude of these potential energy savings is illustrated in Figure 4.

Work performed under Increments C, D, and E includes the analysis of solar energy systems and total, selective and conventional thermal central energy systems fueled by wood, refuse and/or coal. The total and selective energy systems are essentially cogeneration equipment sized to meet all or part of APG's energy requirements.

Volume IIa-2 of this report, which deals with Increments C, D, and E of the EEA study, is organized into five sections as follows:

- Section 1. Provides the study background, organization, and summarizes the energy conservation impact of all of the recommended Increment A and B projects.

TABLE 4. ENERGY CONSERVATION OPPORTUNITY SUMMARY

OPTION DESCRIPTION	E/C	B/C	ENERGY SAVINGS MBtu/Yr	CWE ($)	ANNUAL SAVINGS ($)	PAYBACK (YRS)	STATUS
CENTRAL HEATING/COOLING PLANTS							
Flue Gas Analyzer	5.67	1.02	4,161	733,898	58,837	12.47	N/R
Boiler Economizer							N/R
Boiler Water Treatment							N/R
Variable Speed Chiller Motor							N/F
Return Condensate	8.95	2.33	15,563	1,739.360	203,507	8.56	O&M
Insulate Pipes							N/R
Add Flue Dampers (Oil Furnaces)	20.17	2.42	1,793	84,294	13,853	6.08	O&M
Automatic Condenser Cleaning	19.98	1.37	3.342	167,287	16,394	10.2	O&M
Reset Chilled Water	43.79	2.45	6,621	151,204	26,944	5.61	ECIP
Chiller Economizer							N/A
Add Flue Dampers and Spark Ignition	20.17	2.42	1,793	84,294	13,853	6,08	O&M
Consolidate Boilers							N/F
EMCS							N/R
Demand Limiting & Start/ Stop Cont.	15.35	2.34	3,180	207,183	36,394	5.69	ECIP
BUILDING SHELL							
Reduce Window Openings	4.7	1.46	5.9	1,260	78	16.2	N/R
Storm Windows	15.02	4.31	7,867	523,912	95,969	5.46	ECIP
Wall Insulation Basewide	24.67	7.07	11,528	467,272	139,331	3.35	ECIP
Wall Insulation (Bldg.517)	26.43	8.86	47.7	1,781	666	2.68	O&M
Roof Insulation	64.54	17.26	29,309	454,094	331,862	1.37	ECIP
Ceiling Insulation (Warehouses)	33.14	8.89	14,782	445.999	169,538	2.63	O&M
Reduce Solar Heat Gain							N/F
Vestibules	.68	.17	3.35	4, 865	35.81	135.84	ECIP
Reduce Door Size							N/A
Doors	77.11	10.18	11,028	143,011	152,011	0.94	O&M
Window Panels	21.67	5.58	11,842	546,362	129,276	4.23	ECIP
LIGHTING							
Add Controls to Shut Lamps Off							N/A
Use Higher Efficient Source	14.21	2.32	4,746	333,929	36,265	9.21	ECIP
Reduce Height of Luminaires							N/A
Add Switching							N/A
Use Automatic Dimming Controls	12.7	0.6	3,518	276,591	8,828	31.3	N/R
Site Lighting	12.1	1.2	1,019	84,388	5,136	16.4	N/R
Replace Incandescent (Bldg. 507)	17.1	2.0	287	16,837	1,446	11.6	O&M

TABLE 4. ENERGY CONSERVATION OPPORTUNITY SUMMARY (Continued)

OPTION DESCRIPTION	E/C	B/C	ENERGY SAVINGS MBtu/Yr	CWE ($)	ANNUAL SAVINGS ($)	PAYBACK (YRS)	STATUS
LIGHTING (Continued)							
Replace Incandescent (Family Housing Kitchens)	12.5	1.5	173	13,838	872	15.9	N/R
Replace Incandescent (Family Housing)	11.6	1.2	6,945	497,414	35,003	17.1	N/R
Replace Incandescent (Barracks)	5.7	0.7	529	92,065	2,665	34.5	N/R
High Efficient Fluor. Ballasts	8.1	0.5	0.6	74	3	24.5	N/R
Replace Indandescent (Shop)	27.15	4.49	6,496	239,237	49,112	4.87	ECIP
BUILDING HEATING AND COOLING							
Heat Wheels for Recovery	58.12	10.00	33,220	571,590	394,314	1.45	N/F
Temperature Setback							ECIP
Warm-up Cycle Controls							N/F
Automatic Control Valves for Radiators							N/A
Rezone Heating System							N/A
Economizer Controls							N/R
VAV Systems	11.1	1.56	42,702	3,846,186	265,250	14.5	O&M
Shut Down Air Conditions Systems							N/R
Spot Cooling							N/A
Dead-band Thermostats							N/A
Air Stratification	21.64	6.66	3,169	146,399	41,014	3.57	ECIP
Temperature Setback (Family Housing)							N/R
DOMESTIC HOT WATER							
Use Local Hot Water Heater							N/A
Use Solar Heating							N/R
Desuperheaters	73.17	4.89	2,186	29,871	10,946	2.73	O&M
Insulation, Hot Water Tanks	17.3	1.25	175	10,080	864	11.7	O&M
MISCELLANEOUS							
Use Variable Speed Pumps							N/A
Motor Generator Sets							N/F

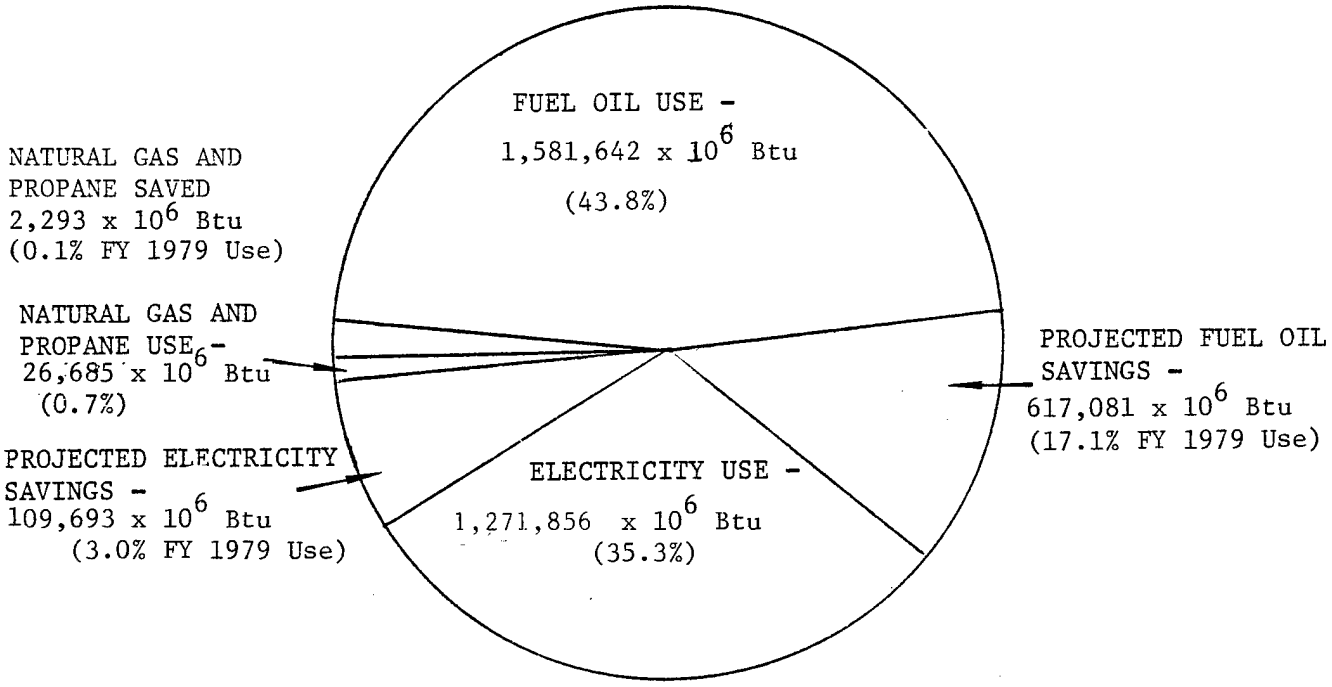
NOTE: N/R - Not required
N/F - Not feasible
N/A - Not applicable

TABLE 5. PRIORITIZED SUMMARY OF ECIP

PROJECT	$\frac{E}{C}$	$\frac{B}{C}$	PAYBACK (YRS)	FUEL ENERGY SAVINGS			ANNUAL ENERGY SAVINGS (10^6 Btu)	ANNUAL COST SAVINGS ($)	CWE ($)
				OIL (10^6 Btu)	GAS (10^6 Btu)	ELECT. (10^6 Btu)			
Ceiling Insulation	64.54	17.26	1.37	25,693	-	3,616	29,309	331,862	454,094
Modify EMCS to Include Night Setback of Heating Systems	58.12	10.00	1.45	33,220	-	-	33,220	394,314	571,590
Reset Controls on Centrifugal Chillers	43.79	2.45	5.61	-	-	6,621	6,621	26,944	151,204
Replace Incandescents in Shops	27.15	4.49	4.87	-	-	6,496	6,496	49,112	239,237
Wall Insulation	24.67	7.07	3.35	11,217	-	311	11,528	139,331	467,272
Window Panels	21.67	5.58	4.23	9,774	-	2,068	11,842	129,276	546,362
Reduce Temperature Stratification	21.64	6.66	3.57	3,426	-	-257	3,169	41,014	146,399
Demand Limiting & Forecasting & Start/Stop Controls	15.35	2.34	5.69	-	-	3,180	3,180	36,394	207,183
Storm Windows	15.02	4.31	5.46	7,767	-	100	7,867	95,969	523,912
Energy Efficient Lighting Systems	14.21	2.32	9.21	-	-	4,746	4,746	36,265	333,929
TOTALS				91,097	-	26,881	117,978	1,280,481	3,641,182

TABLE 6. SUMMARY OF INCREMENT G PROJECTS

PROJECT	E/C	B/C	EC/CC	PAYBACK (YRS)	FUEL ENERGY SAVINGS OIL (10^6 Btu)	FUEL ENERGY SAVINGS GAS (10^6 Btu)	FUEL ENERGY SAVINGS ELECT. (10^6 Btu)	ANNUAL ENERGY SAVINGS (10^6 Btu)	ANNUAL COST SAVINGS ($)	CWE ($)
Install Strip Doors and Dock Shelters	77.1	10.2	15.1	0.9	10,960.5	0	67.1	11,027.5	152,591.	143,010.
Refrigerant Waste Heat Recovery	70.0	4.7	6.9	3.1	0	0	2,185.7	2,185.7	10,081.	31,220.
Ceiling Insulation	37.5	9.3	13.6	2.5	7,041.0	0	4,338.0	11,379.0	121,423.	302,836.
Wall Insulation	26.4	8.9	13.0	2.7	47.1	0	0	47.1	666.	1,781.
Eliminate Unnecessary Roof Vents	21.0	7.1	10.3	3.4	374.0	0	0	374.0	5,288.	17,775.
Electronic Ignitors and Flue Gas Dampers	20.2	2.4	3.5	6.1	747.6	1,045.3	0	1,792.9	13,853.	84,294.
Automatic Condenser Tube Brush Cleaners	22.3	1.4	2.2	8.9	0	0	1,946.0	1,946.0	9,808.	87,157.
Insulate Domestic Hot Water Tanks	17.3	1.3	1.8	11.7	17.6	92.9	64.2	174.7	864.	10,080.
Condensate Return	19.0	6.3	10.1	4.0	13,413.0	0	-338	13,075.0	170,737.	688,461.
Replace Incandescent Lamps - Bldg. 507	17.1	2.0	2.7	11.6	0	0	287.0	287.0	1,446.	16,837.
Replace Incandescent Lamps in Family Housing Kitchens	14.6	1.7	2.3	11.3	0	0	1,949.0	1,949	11,838.	133,818.
TOTALS					32,600.8	1,138.2	10,498.9	43,099.7	498,595.	1,517,269.



TOTAL PROJECTED ENERGY USE - FY 1985 - 2,880,183 x 10^6 Btu per year

TOTAL PROJECTED SAVINGS OVER FY 1975 BASELINE - 20%; 729,067 x 10^6 Btu per year

TOTAL HISTORICAL ENERGY USE - FY 1979 - 3,609,250 x 10^6 Btu per year

TOTAL BASELINE ENERGY USE - FY 1975 - 3,673,728 x 10^6 Btu per year

TOTAL PROJECTED ENERGY COST SAVINGS - $10,675,000 per year in 1986

NOTE: PERCENTAGES IN THIS FIGURE ARE DIRECTLY COMPARABLE TO THOSE ENERGY USE VALUES FOR FY 1979

FIGURE 4. TOTAL PROJECTED ENERGY USE AND SAVINGS AT ABERDEEN PROVING GROUND - FY 1985

- Section 2. Deals with solar and renewable energy systems. This section presents a summary of potential solar technologies, engineering and economic evaluation of conceptual designs, and recommended solar and renewable energy applications.

- Section 3. Describes the feasibility of using total energy and selective energy plants. This section discusses the inherent tradeoffs that occur in the simultaneous generation of steam and electricity. Potential uses of refuse derived fuel and wood fuel are described and discussed in detail.

- Section 4. Presents an analysis of proposed central coal-fired plants used to heat the installation. Alternative plant types and sizes are discussed.

- Section 5. Presents summary information in accordance with the development of a coordinated Basewide Energy System Plan.

The design and analysis of the various projects discussed in Increments C, D, and E are based on FY 1985 energy use. This energy use was identified by FY 1979 energy use outlined in Increments A and B, and modifications due to on-going and proposed energy conservation projects, demolition, and new building construction.

Solar, geothermal, wind, biomass and refuse derived energy were considered as renewable energy resources. Refuse and biomass are also evaluated as fuel for central heating plants. Wind and geothermal potential were virtually non-existant. Solar energy potential is promising and is analyzed in depth.

Solar energy systems are evalauted for domestic hot water (DHW), space heating, processes, and space cooling. DHW considerations include direct and indirect gain systems. Space heating systems include liquid and air active systems; solar assisted heat pumps; and direct, indirect, and/or isolated gain passive systems. High temperature concentrating collectors and evacuated tube systems are considered for process heat application. Solar absorption cooling with flat-plate collectors is also analyzed.

Evaluation of solar projects includes a screening process based on elementary criteria, technical assessment through computer modeling, and economic analysis based on Army criteria. Screening criteria include site

acceptibility, favorable load factors, ease of building integration, system performance and availability, and maximum payback periods. The first three factors are addressed in field surveys and Increments A and B data analysis. System availability and performance are identified through computer modeling with F-Chart (active systems) and PASCALC (passive systems) computer programs. Economic analysis is based on Engineering Technical Letter 1110-3-302. The applications that successfully meet all established criteria are listed in Table 7. Detailed discussions of these applications can be found in Section 2 of Volume IIa-2.

Converting to Central Energy Plants is considered as a means of reducing dependency on petroleum products. The alternative solid fuels include refuse, wood, and/or coal which will fire selective, total, and conventional thermal energy systems. Conventional system options include the comparison between 125 psig steam and 400°F High Temperature Hot Water (HTHW) systems with either direct burial Ric-Wil or concrete channel pipe distribution systems. For economic reasons, only those buildings within reasonable distance of the plant and with significant thermal loads are connected to the plant. Selective Energy (SE) systems are 850 psig, 900°F steam generators which supply steam to buildings to satisfy thermal loads and to steam turbines for the generation of electricity. As with conventional systems, only those buildings that can be economically connected to a central plant are fed by the SE systems. The amount of electricity supplied by the SE systems is limited by the demand for building steam. The Total Energy (TE) systems are the same as the SE systems in all but one respect; TE systems are sized to supply 100% of the base electrical and thermal requirements. Each of the system types (conventional, SE, and TE) are evalauted for a single plant in each of the major areas of APG (i.e., Aberdeen Area and Edgewood Area). The proposed central plants and the related distribution systems are shown in Figures 5 and 6. In addition to these, SE systems for central plants 345, E3312, and E5126 are considered.

The primary fuel selected to fire the central plants is coal. While wood biomass is economically attractive, the supply of wood in the immediate area of APG, is adequate for use only as a supplementary fuel. The use of refuse derived fuel (RDF) as a supplement for coal is not recommended for technical

TABLE 7. ABERDEEN/EDGEWOOD POTENTIAL BASEWIDE ENERGY SAVINGS FROM SOLAR APPLICATIONS WITH LESS THAN 25 YEARS PAYBACK

APPLICATION	BUILDING USE	(MegaBtu/Yr) Load	(MegaBtu/Yr) Solar Energy Delivered	(MegaBtu/Yr) Energy Savings	(MegaBtu/Yr) Cumulative Energy Savings
• Passive Solar Space Heating	-Warehouse	34,489	6,898	9,854	
	-Service	5,784	1,157	1,653	
	-R & D	9,327	1,865	2,665	
		49,600	9,920	14,172	14,172*
• Active Solar Water Heating	-Housing	10,938	8,750	12,500	
	-Service	1,622	1,298	1,854	
	-Office	118	94	134	
		12,678	10,142	14,488	28,660*
• Active Solar Space/ Water Heating	-Housing	6,025	3,916	5,595	
	-Service	1,046	679	970	
	-Office	167	109	155	
		7,238	4,704	6,720	35,380
• Active Solar Space Heating	-Housing	12,031	7,820	11,171	
	-Warehouse	15,698	10,204	14,577	
	-Service	4,114	2,674	3,820	
	-Office	3,630	2,359	3,371	
	-R & D	9,335	6,067	8,668	
	-Shops	226	147	210	
		45,034	29,271	41,817	77,197
• Active Solar Heating, Cooling, and Water Heating	-Housing	8,366	2,041	2,537	79,734

*Projects with less than 15 years payback.

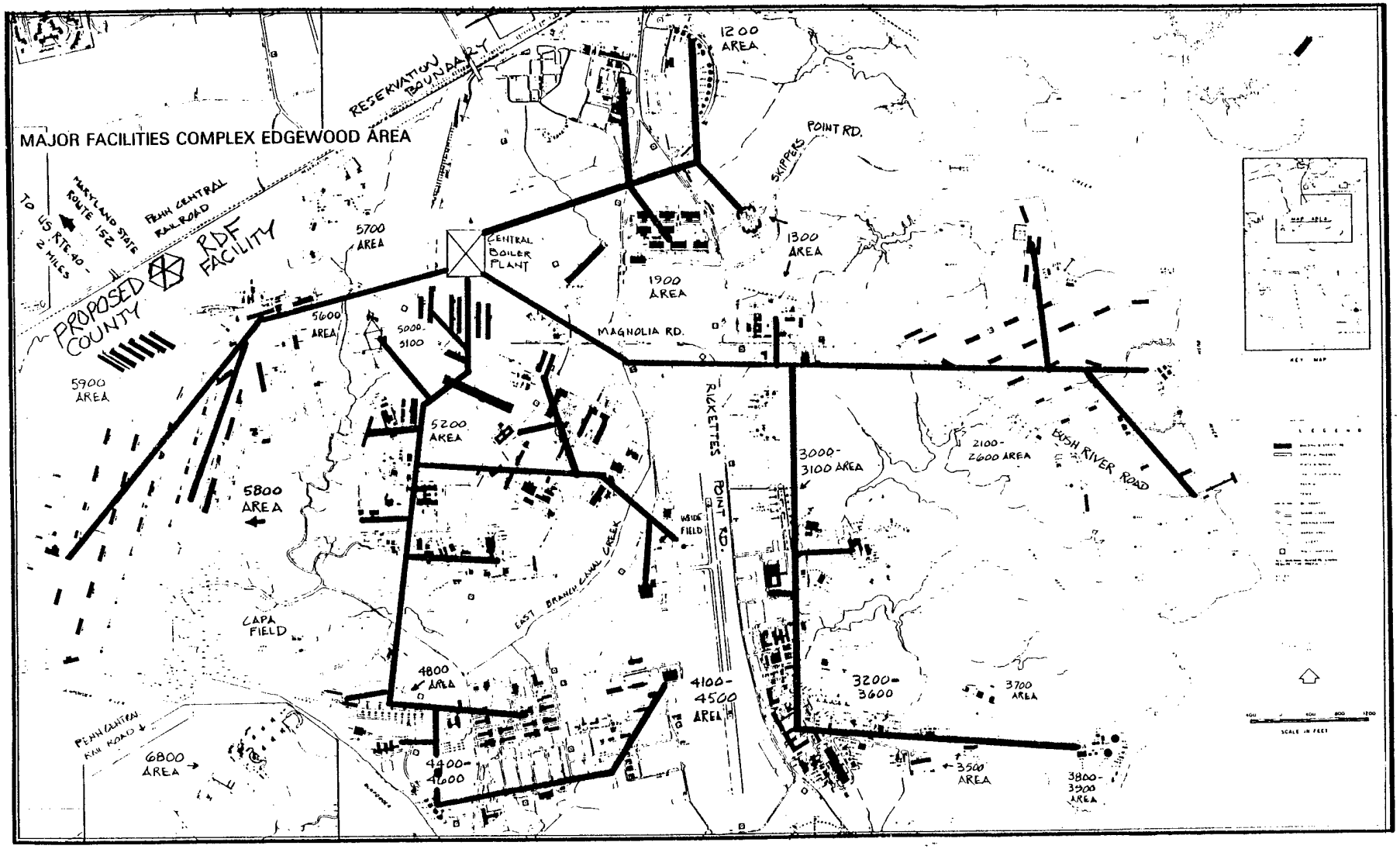


FIGURE 5. PROPOSED EDGEWOOD AREA CENTRAL PLANT AND DISTRIBUTION SYSTEM

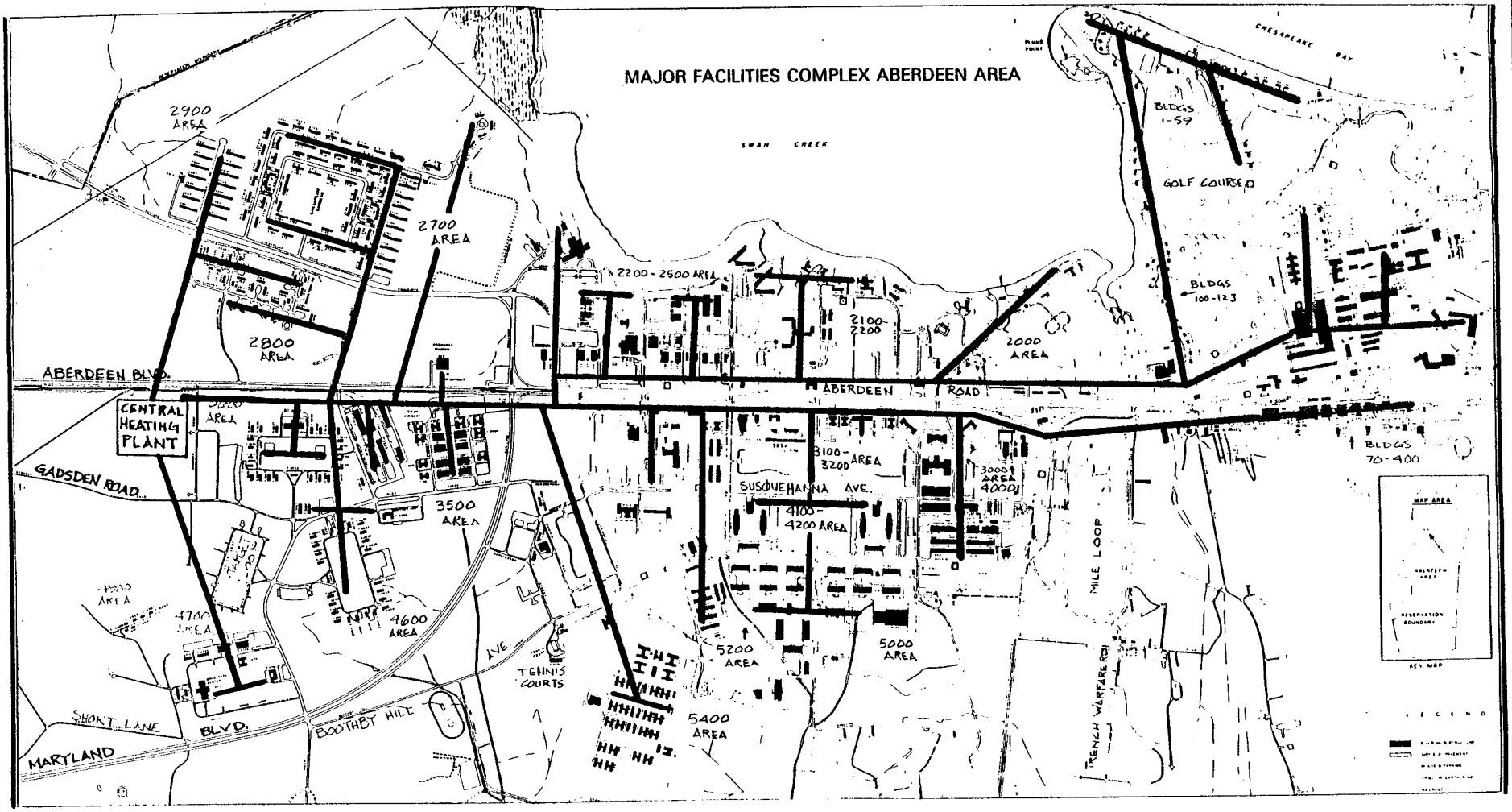


FIGURE 6. PROPOSED ABERDEEN AREA CENTRAL PLANT AND DISTRIBUTION SYSTEM

and economic reasons. Coal boilers can not burn RDF without expensive and presently unreliable refuse separating procedures. At this point in time, heat recovery from modular incineration of refuse is the only proven method of generating energy from waste. The small supply of on-post refuse will not justify the cost or risk of separation, nor will it reasonably supply a post operated refuse incinerator with heat recovery capabilities. A refuse fired energy system is currently being developed to handle Harford County solid waste and steam to the Edgewood Area installation. The plant will be owned and operated by a non-federal government group sponsored by the State of Maryland and will sell steam to Edgewood at a discount rate.

The analysis of Central Thermal Plant Options shows a HTHW system with distribution system piping installed in ground level concrete channels to be the most cost effective central plant. The initial investment and annual maintenance cost for the concrete channel pipe is less than corresponding costs for Ric-Wil, conduit protected, direct burial pipe. HTHW systems also have lower initial investment and annual maintenance costs when compared to steam system costs. The major factors that affect the increase of the steam system cost over the HTHW system are the additional equipment required in the boiler house and the higher cost of the distribution system components.

Comparison of SE, TE, and conventional thermal systems indicate conventional thermal systems are the most economical. Table 8 shows the results of Life Cycle Cost (LCC) analysis performed on the various systems. The HTHW systems are the least expensive in terms of LCC. The Life Cycle Energy Consumption is essentially the same as the base case. Central Plant Selective Energy systems can save approximately 10% of the base energy use but are considerably more expensive than the conventional thermal systems and are not recommended.

The energy use impact of the proposed alternative energy systems reduces the projected basewide FY 1985 energy use from 2,980 to 2,490 billion Btu per year. This energy savings is in heating fuel. The electrical energy use should not change significantly due to the implementation of any of the

APG MARYLAND PROPOSED CENTRAL PLANT OPTIONS

	Area[1]	SUMMARY OF COST DATA - $1,000							LIFE CYCLE COST ($1,000)	Percent of Base LCC	LCC Energy Consumpt. 10^9 Btu	Percent of Base Energy	ANNUAL SAVINGS[2]	
		Initial	MAINTENANCE Annual	MAINTENANCE Nonre-occurring	Coal	Oil	Elec.	Natural Gas &/or Propane					$1,000	10^9 Btu
Base Case	AA	0	1,831.6	0	0	8,908.7	2,092.6	117.6	234,592	--	42,164.5	--	--	--
	EA	0	1,297.2	0	0	6,721.8	1,409.6	54.7	175,038	--	30,917.5	--	--	--
HTHW - Thermal Only 25 Yr Life	AA	75,267.8	1,096.3	87.6	1,881.0	822.2	2,219.2	34.5	182,978	78	43,249.3	103	2,064.6	-43.4
	EA	45,135.1	913.2	72.6	1,212.8	1,001.6	1,483.3	12.6	128,628	73	30,249.1	98	1,956.4	26.7
Selective Energy Replacing Bldg. #'s 345, E3312 & E5126 25 Yr Life	AA	16,507.0	1,204.3	0	365.3	7,498.6	2,086.9	117.6	262,226	112	42,677.3	101	-1,105.4	-20.5
	EA	47,850.0	1,148.8	0	1,057.9	3,088.3	1,145.2	54.7	175,533	100	31,121.6	101	-19.8	-8.2
Selective Energy 2 Proposed Plants 25 Yr Life	AA	110,370.3	1,761.4	0	2,220.0	822.2	1,115.4	34.5	205,879	88	38,882.4	92	1,148.5	131.3
	EA	74,913.6	1,362.6	0	1,454.3	1,001.6	837.5	12.6	152,550	87	27,602.1	89	899.5	132.6
Total Energy Systems 2 Proposed Plants 25 Yr Life	AA	122,130.3	1,493.3	0	4,140.5	0	0	0	201.845	86	52,005.4	123	1,282.1	-393.6
	EA	101,630.9	1,242.2	0	4,140.5	0	0	0	158,706	91	36,020.4	117	653.3	-204.1

NOTES: (1) EI = Engineering Instruction Escalation Rates; HIST = Historical Excalation Rates
(2) AA = Aberdeen Area; EA = Edgewood Area
(3) Annual Savings = (Total Base - Total Proposed) ÷ No. of Years
(4) Life Cycle Cost Analysis was based on the "Engineering Instructions for Preparation of Feasibility Studies for Total Energy, Selective Energy, and Heat Pump Systems" DAEN-MCE-U, 1 July 1977. These are for comparison purposes only and do not represent actual costs.

TABLE 8. ECONOMIC SUMMARY OF CONVENTIONAL, THERMAL, SELECTIVE, AND TOTAL ENERGY SYSTEMS

proposed systems. A summary of alternative energy savings is shown in Table 9. An additional 32 percent savings of petroleum products can be accomplished by construction of a central coal-fired boiler plant in the Aberdeen Area. As can be seen in Table 10, it appears that the energy use goals up to the values for FY 2000 are reachable.

Increment F of the Basewide Energy Systems Plan for APG evaluates energy conservation for Facility Engineering and presents a summary of projects implemented and planned.

Four Facility Engineering projects were evaluated and are summarized in Table 11. The first three projects are economcially sound energy saving options and are recommended for implementation. The total expected savings from these options is approximately 22 billion Btu per year. The fourth project is a set of four matrices of builidng number versus energy conservation options. This matrix is a managerial tool requested by the Post; it is not a direct energy saver.

In addition to these projects, several energy related training opportunitites have been identified in this section of the report.

TABLE 9. SUMMARY OF ALTERNATIVE ENERGY SAVINGS

ALTERNATIVE ENERGY SYSTEM	ANNUAL ENERGY SAVINGS, MBtu
Solar Systems — 0-15 Year Payback	28,660
Solar Systems — 15-25 Year Payback	51,074
Central Heating Plant — Refuse-fired, Edgewood Area	413,000
TOTAL	492,734

TABLE 10. COMPARISON OF ALTERNATIVE ENERGY AND SOLID FUEL USE VERSUS GOALS

ITEM	ENERGY USE 10^6 Btu/Year	PERCENT OF INSTALLATION FY 1985 USE	PERCENT SUPPLIED BY LISTED SOURCE			
			FY 1985 GOAL	FY 1990 GOAL	FY 1995 GOAL	FY 2000 GOAL
Installation Energy Use — FY 1985	2,923,437		N/A	N/A	N/A	
Alternative Energy Savings	492,734	17%	1%	5%	10%	20%
Solid Fuel Use*	1,375,875	47%	10%	15%	20%	35%

*Includes Aberdeen Area Central Plant coal use and Edgewood Area refuse provided energy

SOURCE OF GOALS: Defense Energy Program Policy Memorandum (DEPPM) No. 80-6, July 1980

TABLE 11. APG INCREMENT F PROJECT SUMMARY

PROJECT NO.	NAME	IMPLEMENTATION	INSTALLATION MANHOURS	ANNUAL SAVINGS		SIR
				MBTU	$	
1	Maintenance of Solid State Controls	8,600	80	400	2,960	5.7
2	Improvements Related to Central Plant 345:					
	Repair of Distribution System	4,400	40	224	1,185	5.1
	Night Setback	292,002	3,070	14,042	104,042	4.6
3	Boiler Repair/Replacement	300,300	2,160	9,123	79,558	4.1
4	Energy Efficiency Matrices		NOT APPLICABLE			
	TOTALS	605,302	5,350	23,789	187,927	

Implementation costs include design and SIOH fees